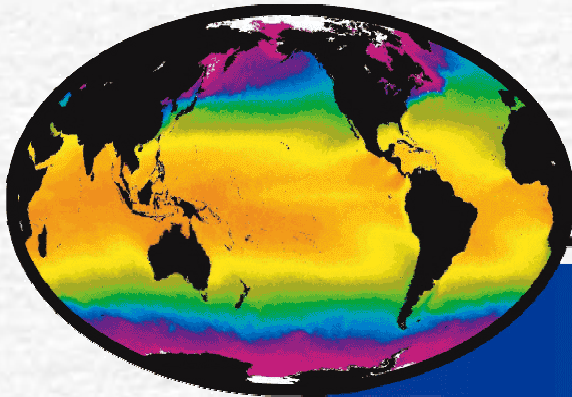


# The GODAE High Resolution Sea Surface Temperature Pilot Project



## GHRST-PP

*GODAE High Resolution Sea Surface Temperature  
Pilot Project*

By

**Craig Donlon**

First presented at the GODAE Symposium “En route to GODAE”, Biarritz,  
France, 14<sup>th</sup> June, 2002.

GHRST-PP Home Page <http://www.ghrsst-pp.org>

# GHRST-PP Science Team

- @ Bill Emery
- @ Chelle Gentemann
- @ Chris Mutlow
- @ Doug May
- @ Gary Wick
- @ Ian Barton
- @ Ian Robinson
- @ Jim Cummings
- @ Neville Smith
- @ Hiroshi Kawamura
- @ Nick Rayner
- @ Peter Minnett
- @ Bob Evans
- @ Pierre LeBorgne
- @ Andy Harris
- @ Ed Armstrong
- @ Ken Casey
- @ Jorge Vasquez
- @ Craig Donlon (chair)

# Overview

- ④ What is the GHRST-PP
- ④ GHRST-PP data product specifications
- ④ The strategic vision
- ④ The implementation plan
- ④ Project Outcomes
- ④ Project Evaluation
- ④ Current status



# What is the GHRST-PP?

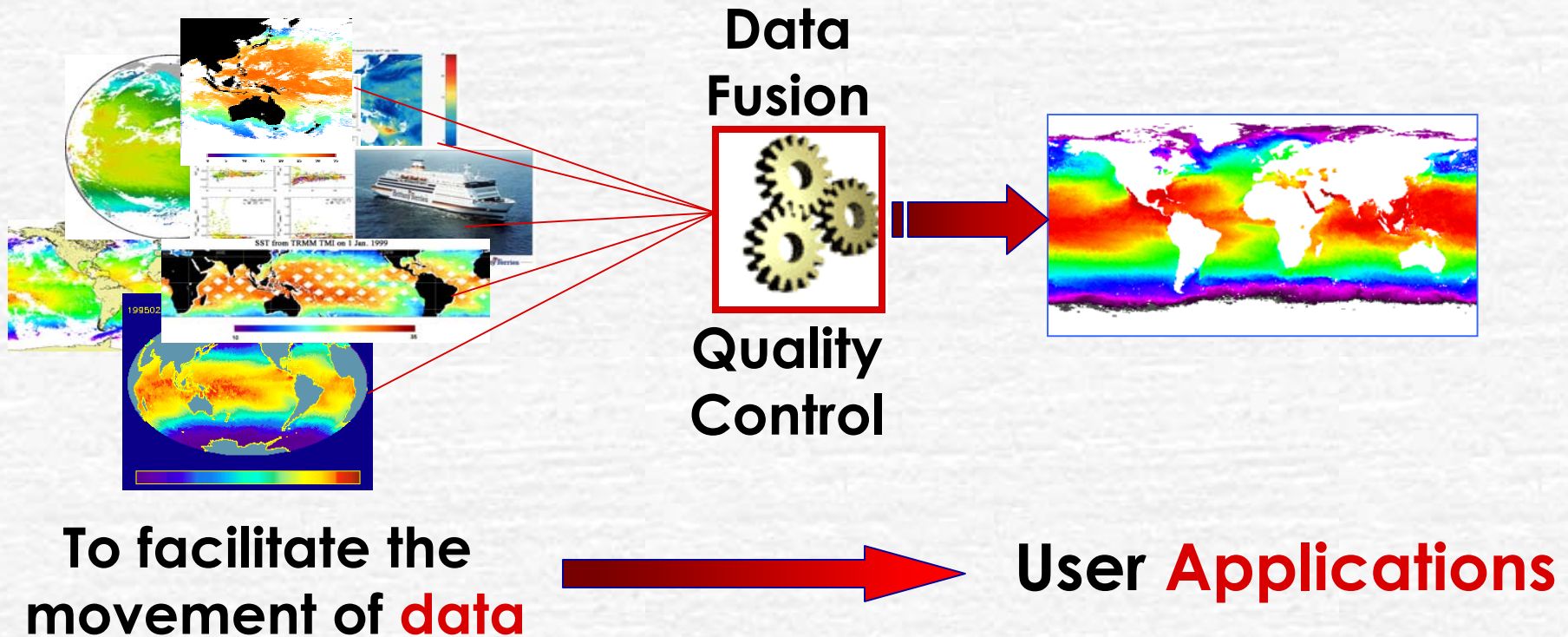
- ② A GODAE Pilot-Project contributing to the GODAE Common as part of the GODAE Measurement Network
- ② Its **primary aim** is to:
  - Oversee the development, timely delivery, assembly and processing high-quality, global scale, SST products at a fine spatial and temporal resolution, for
    - The diverse needs of GODAE,
    - The scientific community,
    - Operational users and,
    - Climate applications.
- ② The broad **objective** of the GHRST-PP is to:
  - **Provide international focus and coordination for the sustained development and application** of a new generation of global, high-resolution, SST products.

# Who are the GHR SST-PP Clients ?

- **GODAE and others with an interest in SST**
  - Ocean and Atmosphere modelling community
  - Climate community
  - Oceanographic Science community
  - Navy offices
  - Governments and research agencies
  - International projects (GOOS, CLIVAR etc.)
  - In situ data providers (SOOP, ARGO, TAO, GDP etc.)
  - Satellite data providers
  - Satellite heat flux developers

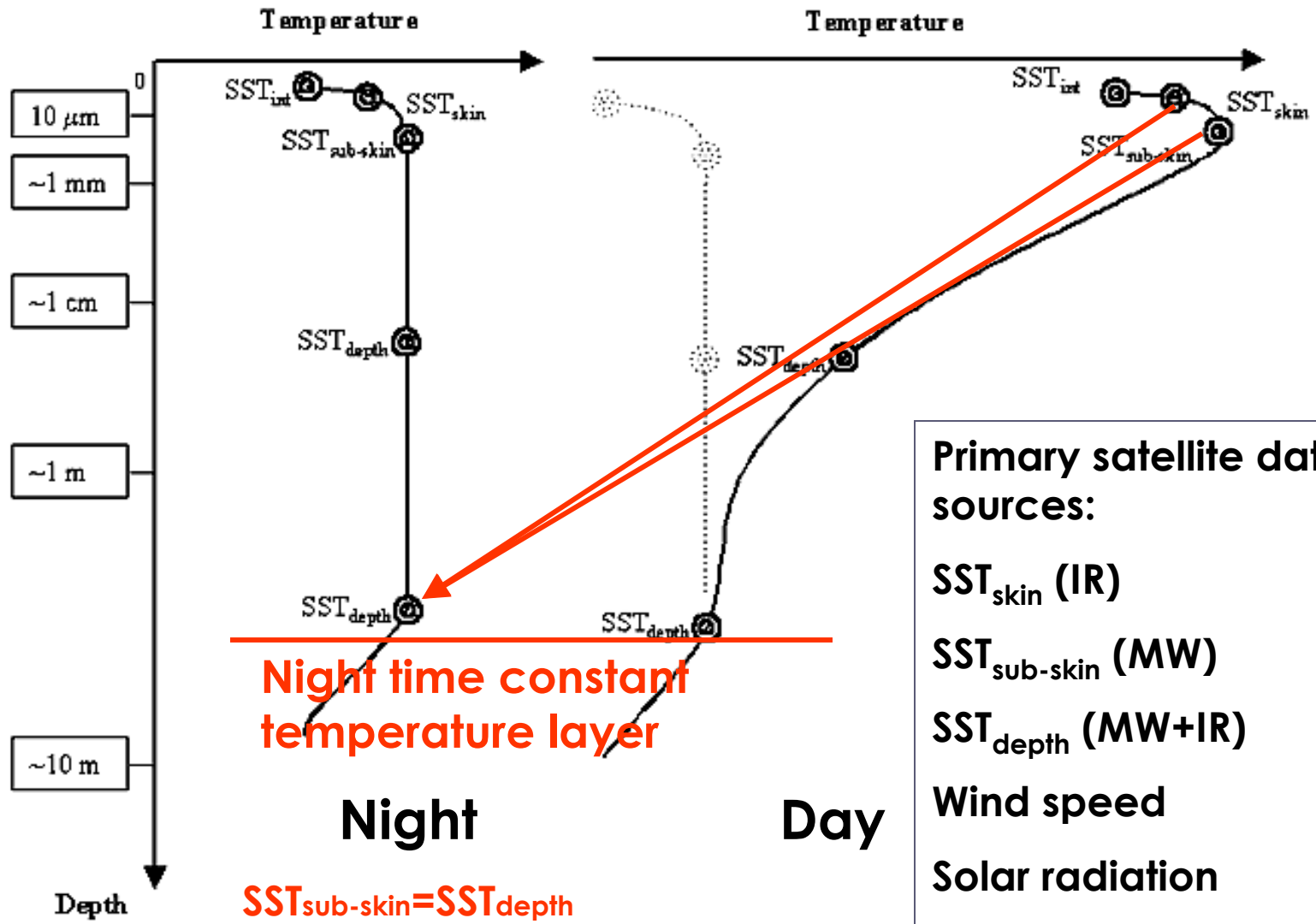
# The GHR SST-PP Concept

- ④ In principle, the **merging and analysis** of complementary satellite and in situ measurements can deliver SST products with enhanced accuracy, spatial and temporal coverage.

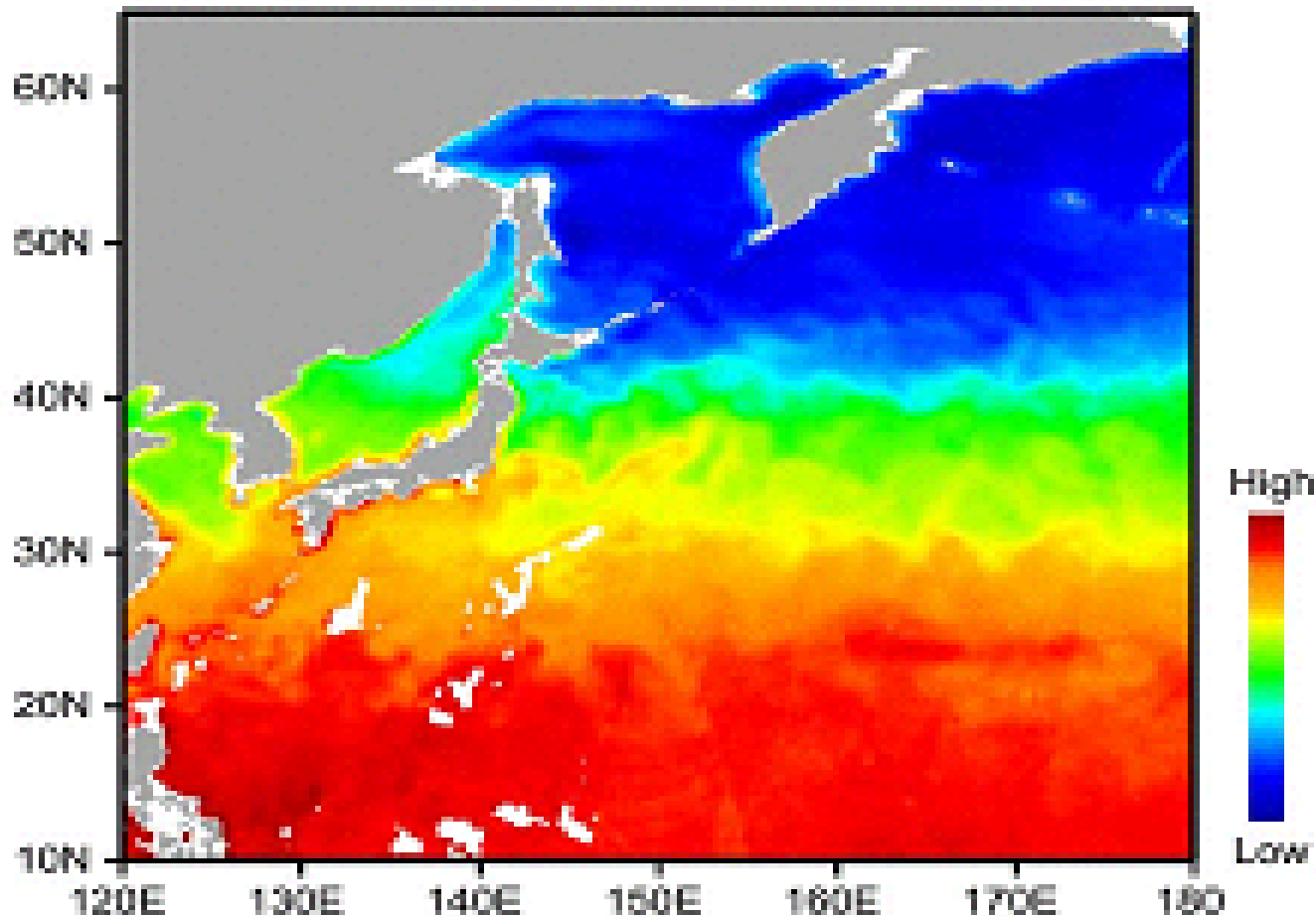




# “Definition” of SST...



# AMSR-E/AQUA Global, Cloud Free SST

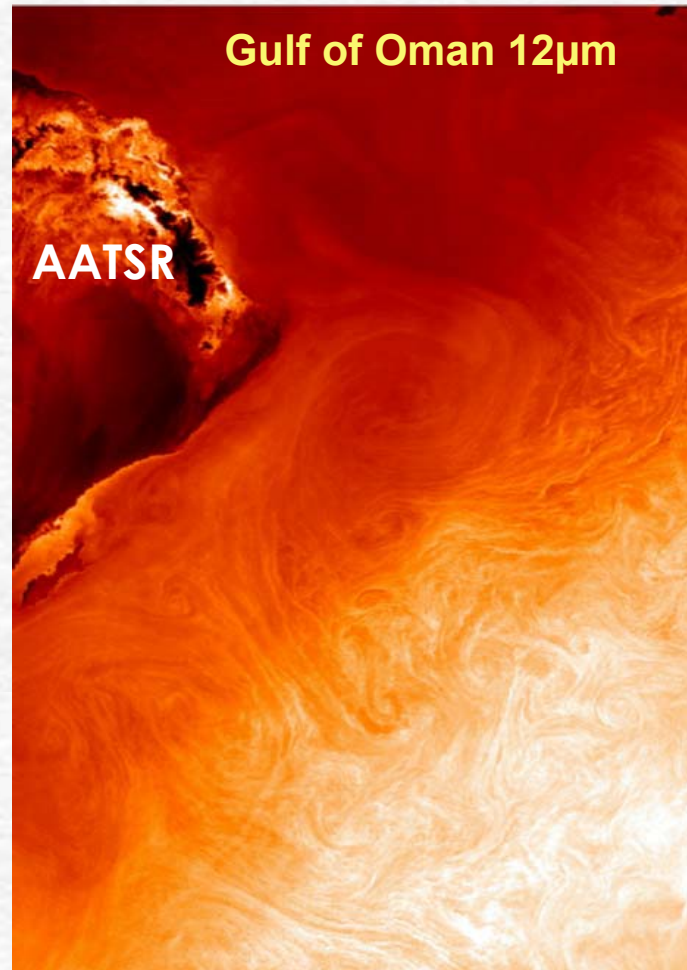
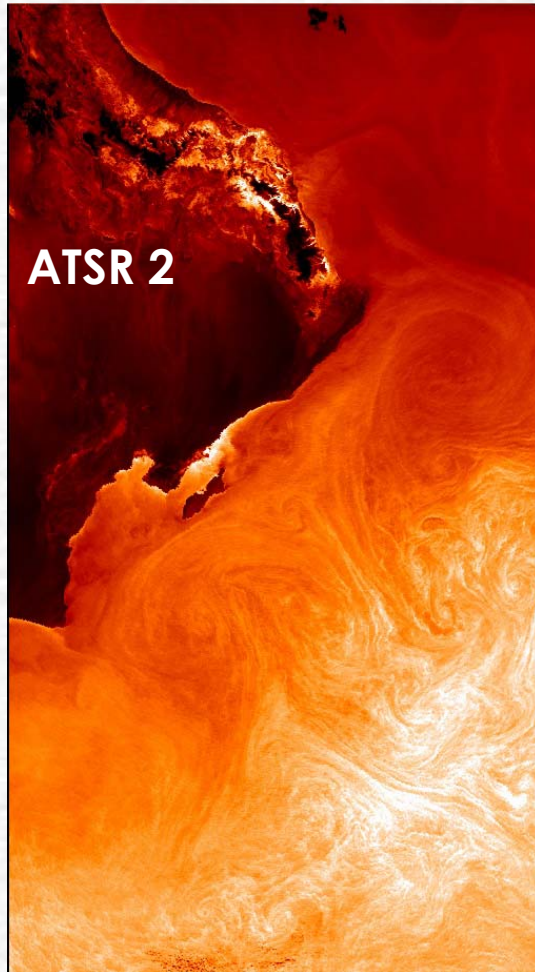


June 2-4 2002 NASDA\_preliminary SST



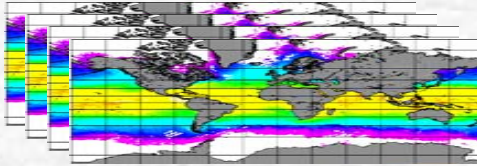
# First ENVISAT AATSR data

(ATSR 2 data acquired ~30 minutes before AATSR data)

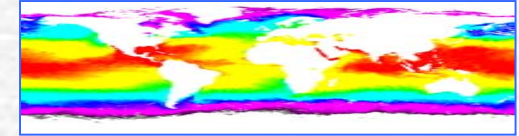


# Data Merging and Data Analysis

**Merged SST**



**Analyzed SST**



A “stack” or collation of different SST data are calibrated, cleared of cloud and then merged to a common grid. Data are assembled in R/T.

Analyzed data products are derived from the merged “stack”.

## Ⓢ **Merged SST (output every 6 hrs):**

- Common grid but variable resolution data
- Individual input data error statistics are preserved
- Products are volatile and change when new data arrives
- Moderate level of quality control
- Only merged 6 hourly data are permanent and archived

## Ⓢ **Analyzed SST (output every 12 hrs):**

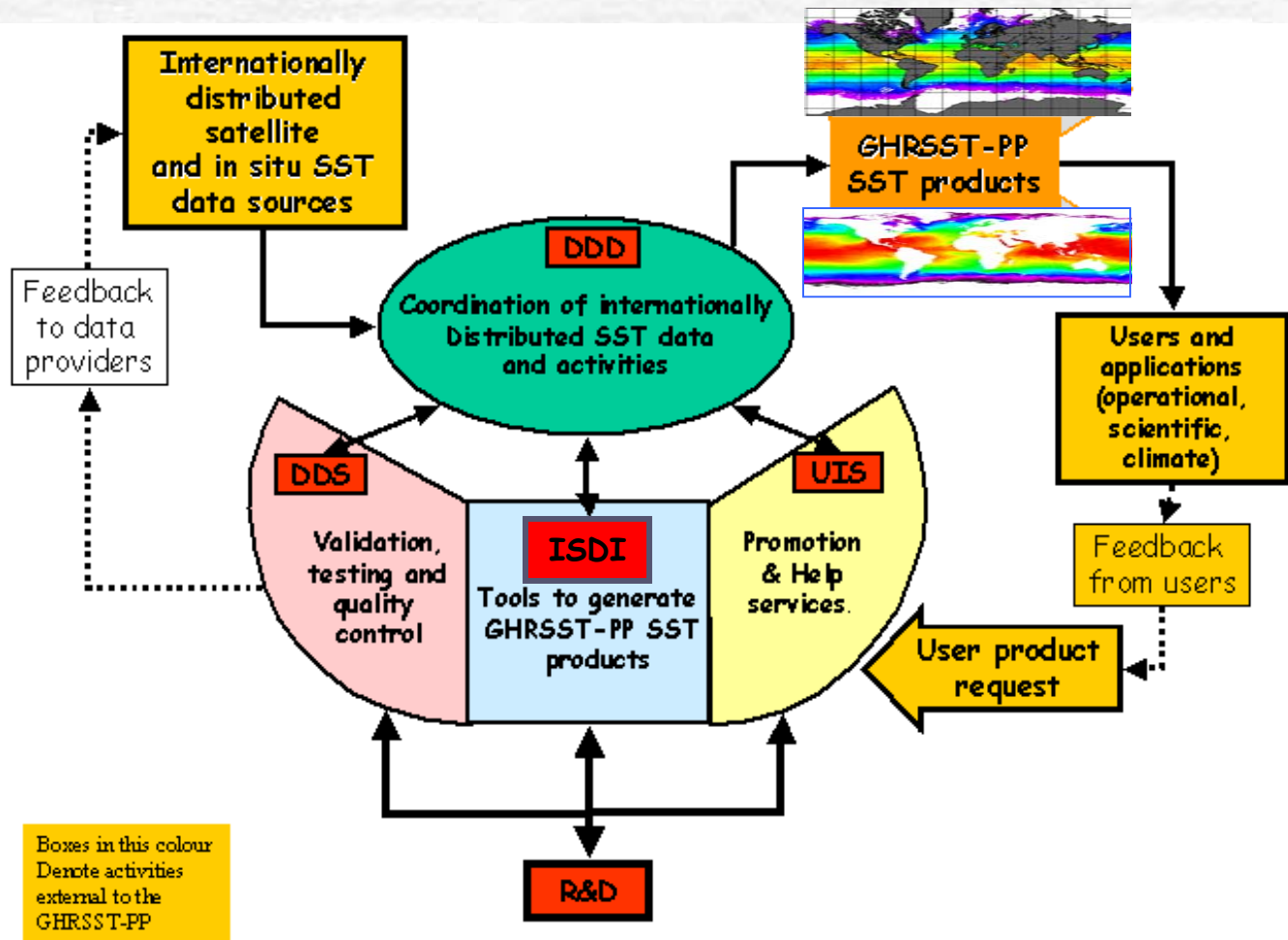
- Single output grid together with confidence data (e.g., diurnal signal)
- High level of quality control
- Error statistics include error of source data and of analysis procedure
- Analyzed data are permanent data that are archived.
- **Analysed data will be improved via reanalysis (7-60 days)**



# GHRST-PP Data Products

	Merged SST	Analyzed SST	Reanalyzed SST
Grid Size	Better than 10 km	Better than 10 km	Better than 10 km
Temporal resolution	6 hours	12 hours	7-60 days
Accuracy	< 0.5 K absolute 0.1 K relative	< 0.4K absolute (target) 0.1 K relative	< 0.3 K absolute (target) 0.1 K relative
Error statistics	rms. and bias for each input data stream at every grid point	rms. and bias for each output grid point (no input data statistics are retained)	rms. and bias for each output grid point (no input data statistics are retained)
Coverage	Regional (Best effort Global)	Global (Regional extracted)	Global (Regional extracted)
SSTskin product	Yes	Yes	Yes
SSTsub-skin product	Yes	Yes	Yes
SST1m product	Yes	Yes	Yes
Cloud mask	For each input	Yes	Yes
Confidence data	No	Yes (sea ice information, diurnal warming mask)	Yes (sea ice information, diurnal warming etc)
Nominal data format	Hdf/GRIB/NetCDF	Hdf/GRIB/NetCDF	Hdf/GRIB/NetCDF

# The GHR SST-PP Thematic strategy



A scientific vision



# GHR SST-PP Strategic Themes

## ② Theme I: (I. Robinson, UK)

- **Specification and delivery mechanism of SST products** required by different users and diverse applications.

## ② Theme II: (C. Donlon, Italy)

- **Characterisation and identification of differences between SST fields** derived from existing satellite and in situ data sources.

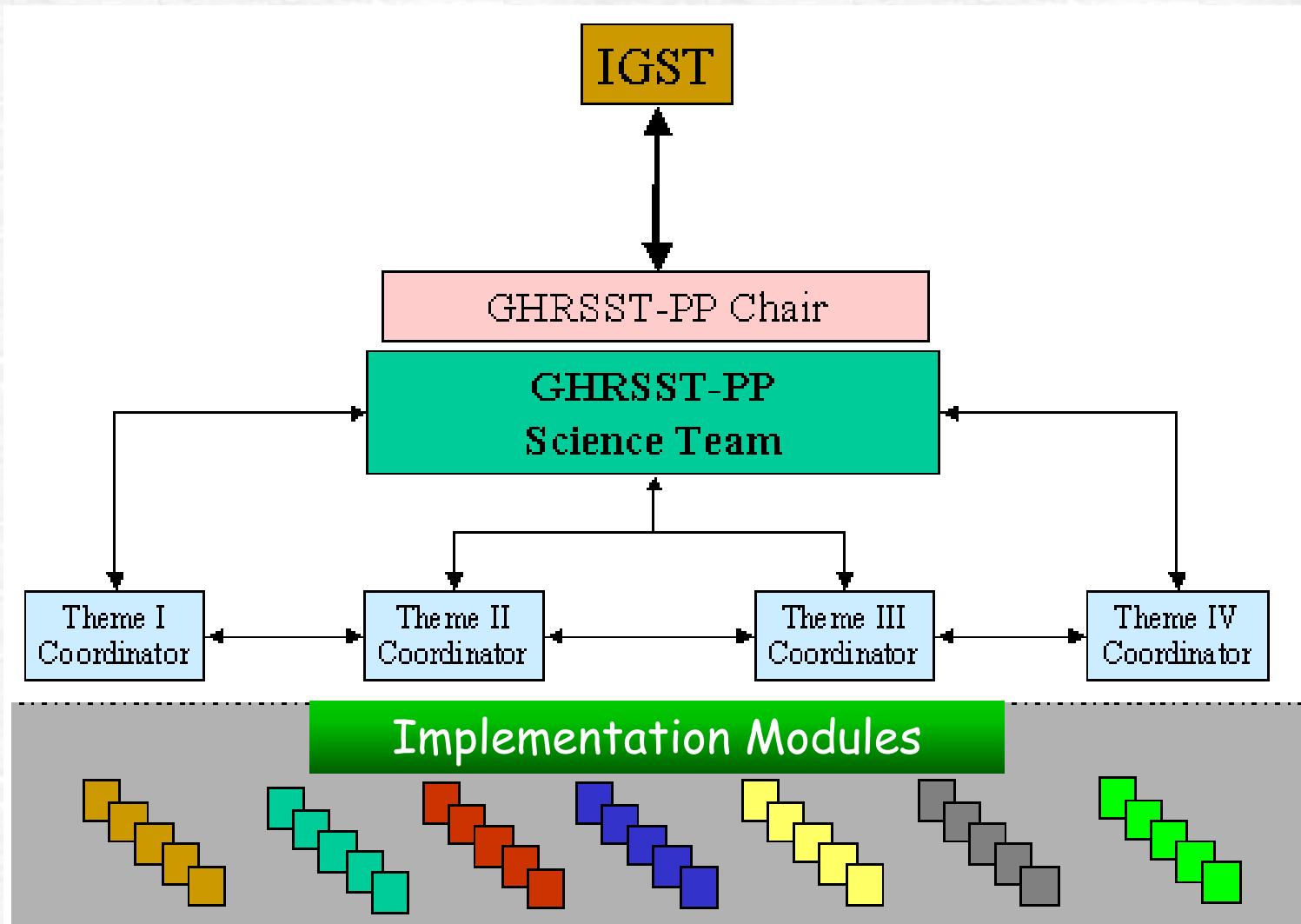
## ② Theme III: (G. Wick, USA)

- **Targeted research and development** for SST data merging and analysis (integration).

## ② Theme IV: (H. Kawamura, Japan)

- **Generation of new improved, multi-sensor, SST products** through integration and assimilation.

# GHRST-PP Organization



# Mapping Strategy to Reality...

- ④ GHR SST-PP needs a **framework for success**
  - Follow a pragmatic approach
  - Use what is already available
  - Build on existing capacity
- ④ Preserve and enhance **regional autonomy and identity**
  - Provide a platform for regional actions
  - Preserve regional infrastructure and R&D investments
  - Leverage regional funding
- ④ Provide a **global project focus**
  - For global data and products, agencies and scientists
  - Metadata – the unifying project “key”
  - Outreach and capacity building
  - Maintain the GODAE identity by working closely with GODAE applications
- ④ Implementation Plan is built on a **layered approach**





User application and user services layer

Global data assembly, merging and analysis layer (GODAE specialist data centre)

Regional data assembly, merging and analysis layer

Regional task sharing project layer

Global and regional coverage data provision layer

\*RDAC: Regional Data Assembly Centre



# Users and Applications

- ④ The User Information Service (**UIS**) provides information on GHR SST-PP **logistics and operations**
  - General access to data products
  - Access and use of the GHR SST-PP GDAC DPCF
  - Services for GHR SST-PP RDAC, GDAC and Agencies
- ④ The Applications and User Services (**AUS**) links the GHR SST-PP to **specific applications** (GHR SST-PP “Power users”) closely monitored by GHR SST-PP science team
  - E.g., MERCATOR, FOAM, JMA, Satellite Flux development etc.
  - Interactive Workshops and targeted outreach initiatives
  - Develop a **deep relationship** with specific applications to ensure **appropriate feedback**

Applications and User Services (AUS)  
Specific real time projects: Models, Assimilation etc.

USERS

User Information Services (UIS)

Reanalysis (UIS-RAN)	Data Product Server (UIS-DP)	GHR SST-PP Web Portal (UIS-WWP)	Data access & archive (DAAC)
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Global Data Analysis Centres (GDAC's)

In situ and Satellite Data Integration (ISDI)	ISDI Technical Advisory group (ISDI-TAG)	Diagnostic Data Set (DDS)	Data Product Computation Facility (DPCF)	GHR SST-PP Metadata repository (MDR)
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Japan RDAC	R-ISDI R-DDS	Europe RDAC	R-ISDI R-DDS	USA RDAC	R-ISDI R-DDS
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NGSST Project	Medspiration project	Cooperative US SST project
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Regional coverage satellite and in situ data (GMS, MSG, GOES, AVHRR-LAC)	Global coverage satellite and in situ data (AVHRR-GAC, AMSR, AMSR-E, AATSR)	Dedicated specialist data servers (NASDA, ESA, JMA, etc)	GTS
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User application and user services layer

Global data assembly, merging and analysis layer (GODAE specialist data centre)

Regional data assembly, merging and analysis layer

Regional task sharing project layer

Global and regional coverage data provision layer

\*RDAC: Regional Data Assembly Centre



# In Situ and Satellite data Integration (ISDI)

## ② SST<sub>skin</sub> based on IR data sets

- E.g., AATSR providing calibration but better coverage derived from AVHRR style sensors and geostationary instruments (5-10 km daily data are possible)

## ② SST<sub>sub-skin</sub> based on MW data sets

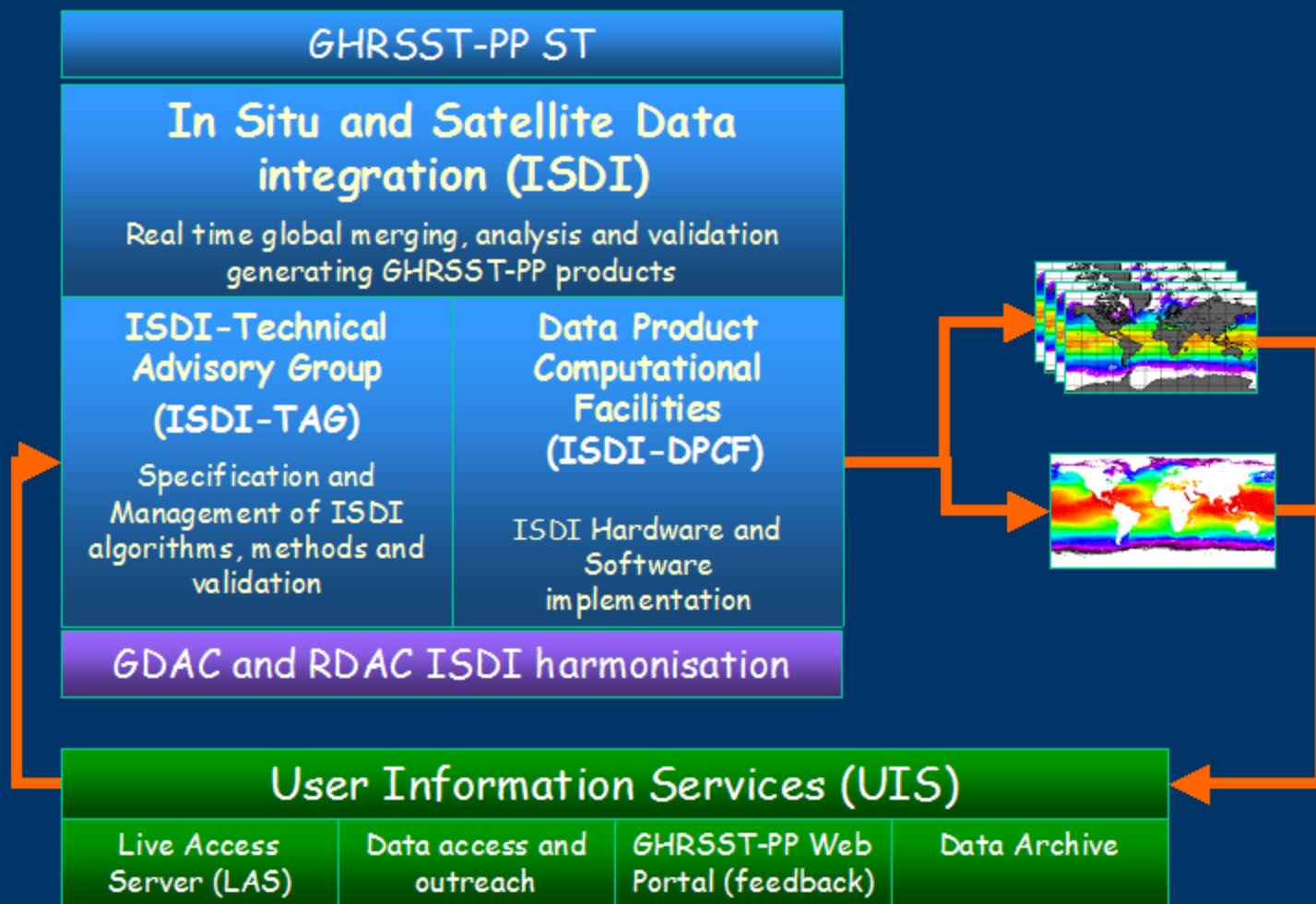
- AMSR, AMSR/E, TMI (~ 25 km, only with IR can higher space resolution be obtained)

## ② SST<sub>1m</sub> based on IR and MW data

- New Generation SST v1.0 algorithm and methods developed by Japanese teams (Kawamura et al.)
  - Simple model of diurnal warming/cooling based on the use wind thresholds for skin<>depth conversion together with estimates of solar radiation
- Indian ocean geostationary coverage remains an issue
- Use wind speed screening alone

- ② A Technical Advisory Group (led by Gary Wick, NOAA) is now (September 2002) concluding a v1.0 ISDI implementation model

# In situ and Satellite Data Integration (ISDI) product control loop





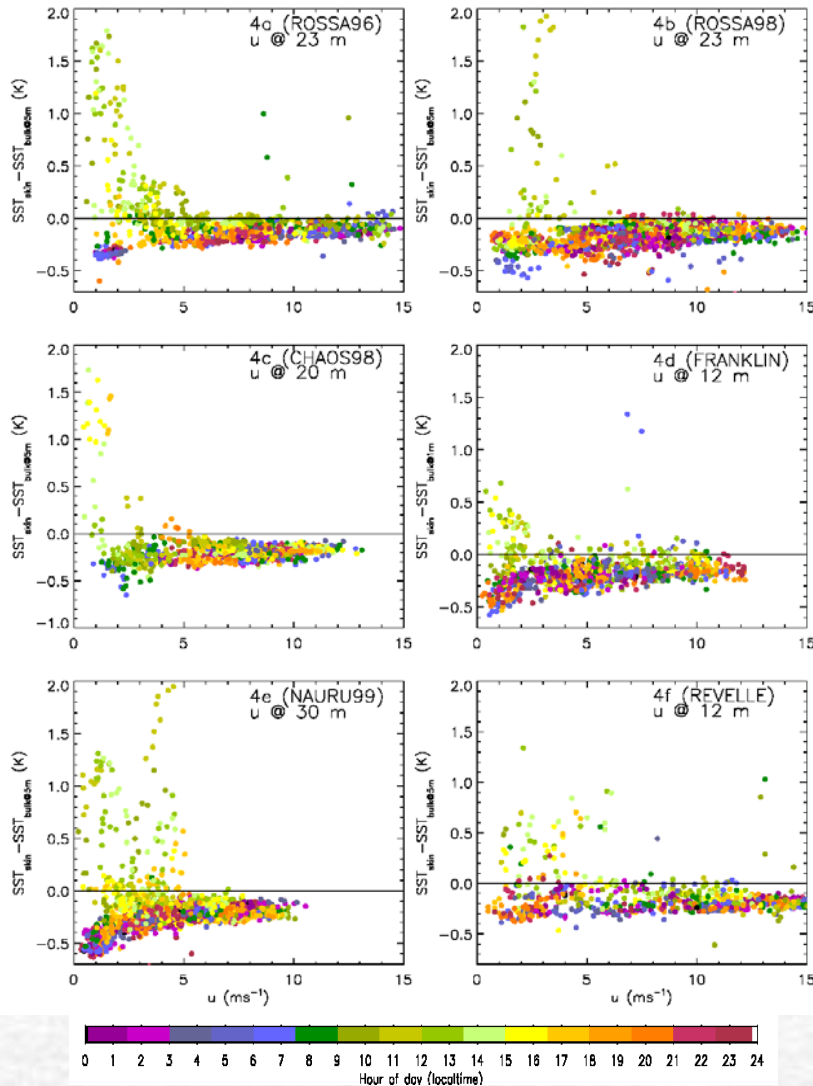
# SST<sub>skin</sub> & SST<sub>depth</sub> Differences

## DAYTIME:

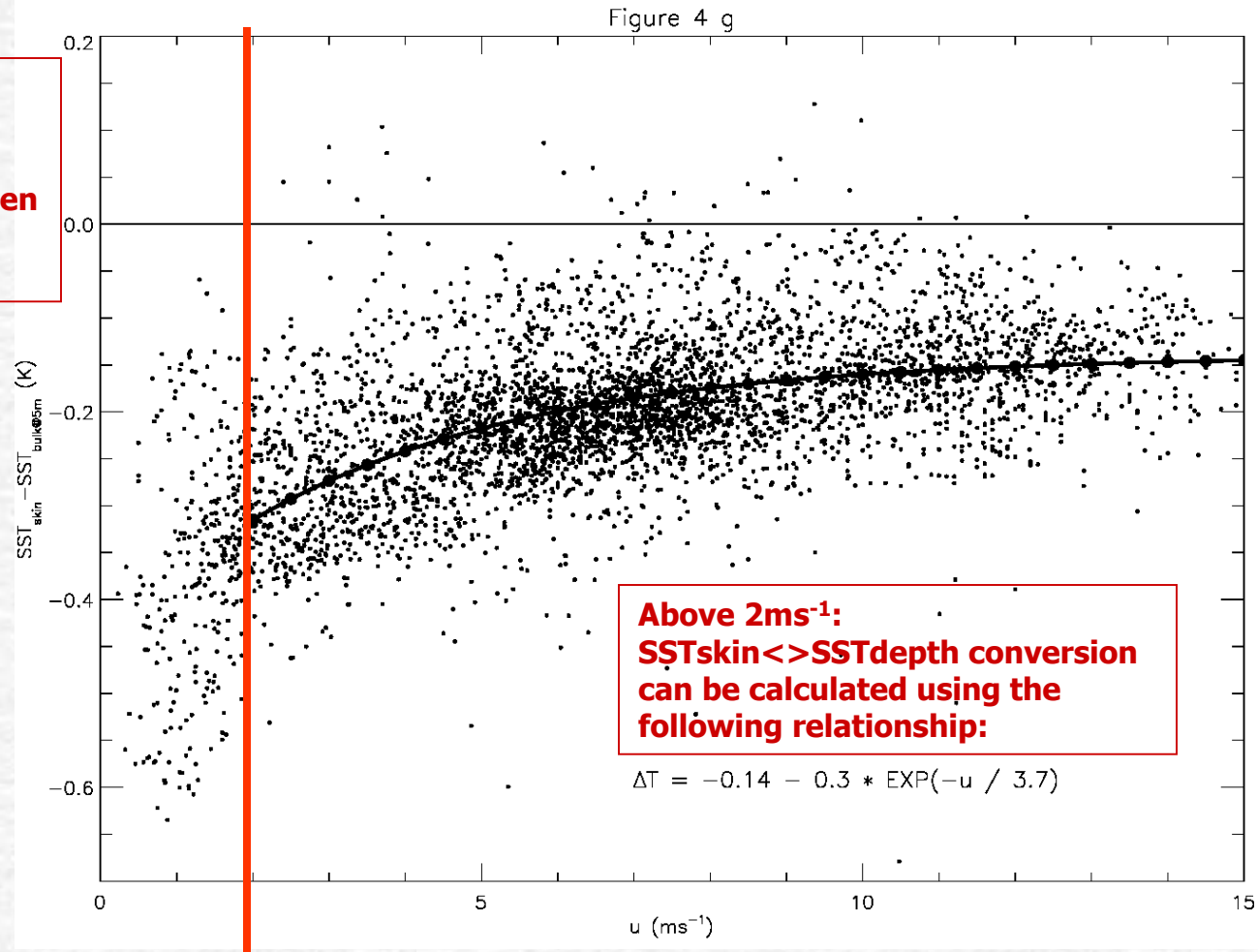
- **Wind speed  $> 6 \text{ ms}^{-1}$ :** a persistent cool skin characterized by  $\sim 0.17 \pm 0.1 \text{ K}$  rms. SST<sub>depth</sub>, corrected for this small offset, may be considered as SST<sub>skin</sub>.
- **Wind speed  $< 6 \text{ ms}^{-1}$ :** modeling of diurnal warming and cool skin effects is **mandatory**.

## NIGHTTIME:

- **Wind speed  $< \sim 2 \text{ ms}^{-1}$ :** convective and molecular heat transfer processes dominate. Modelling of cool skin is mandatory
- **Wind speed  $> \sim 2 \text{ ms}^{-1}$ :** there exists a cool skin layer characterized by  $0.14 \text{ K} + 0.30e(-U/3.7)$

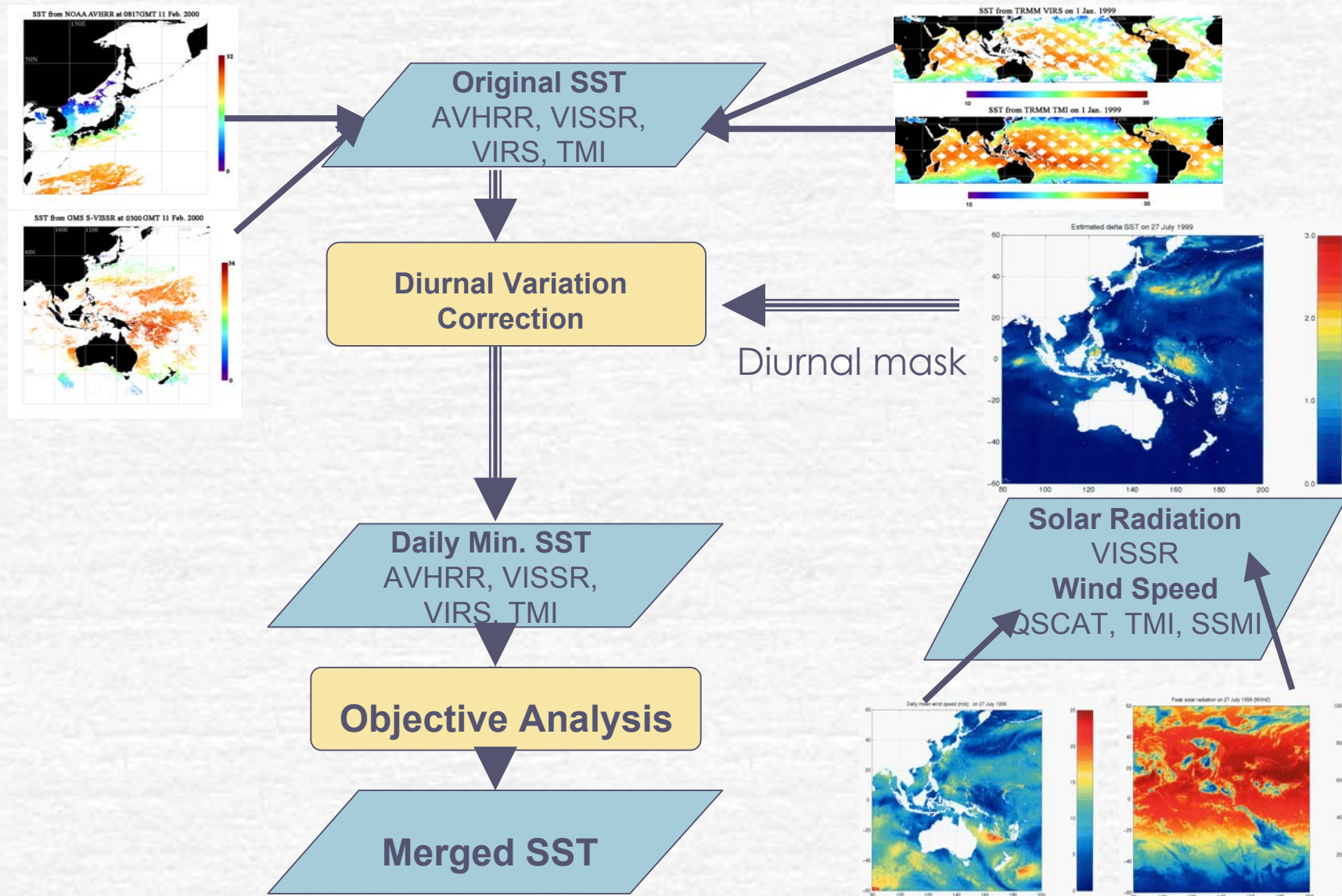


# Empirical conversion of SST<sub>skin</sub> to SST<sub>depth</sub>



\*Donlon et al., J. Climate, January 2002

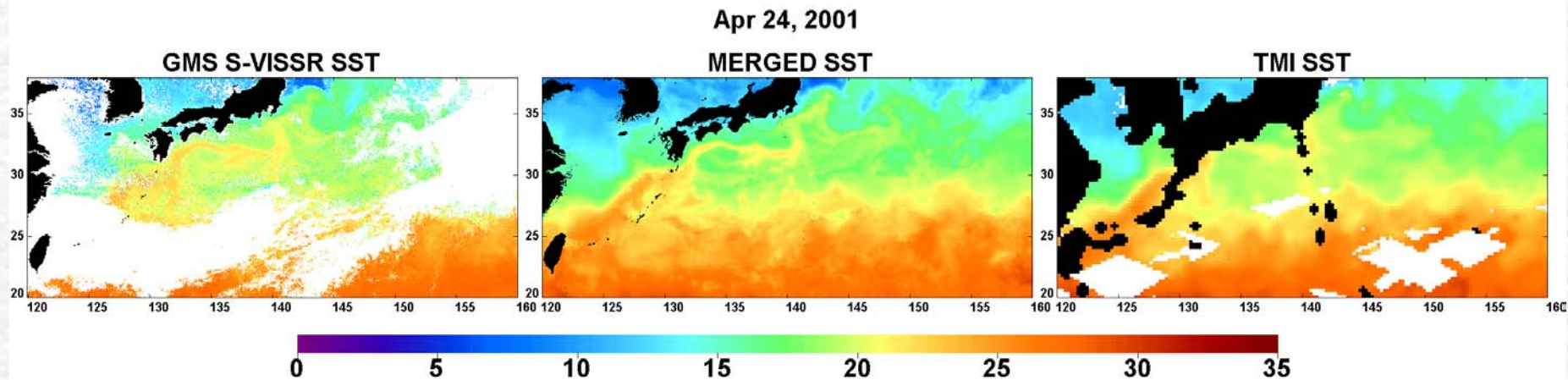
# SST<sub>1m</sub>: The New Generation SST v1.0





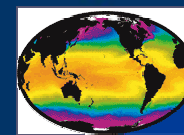
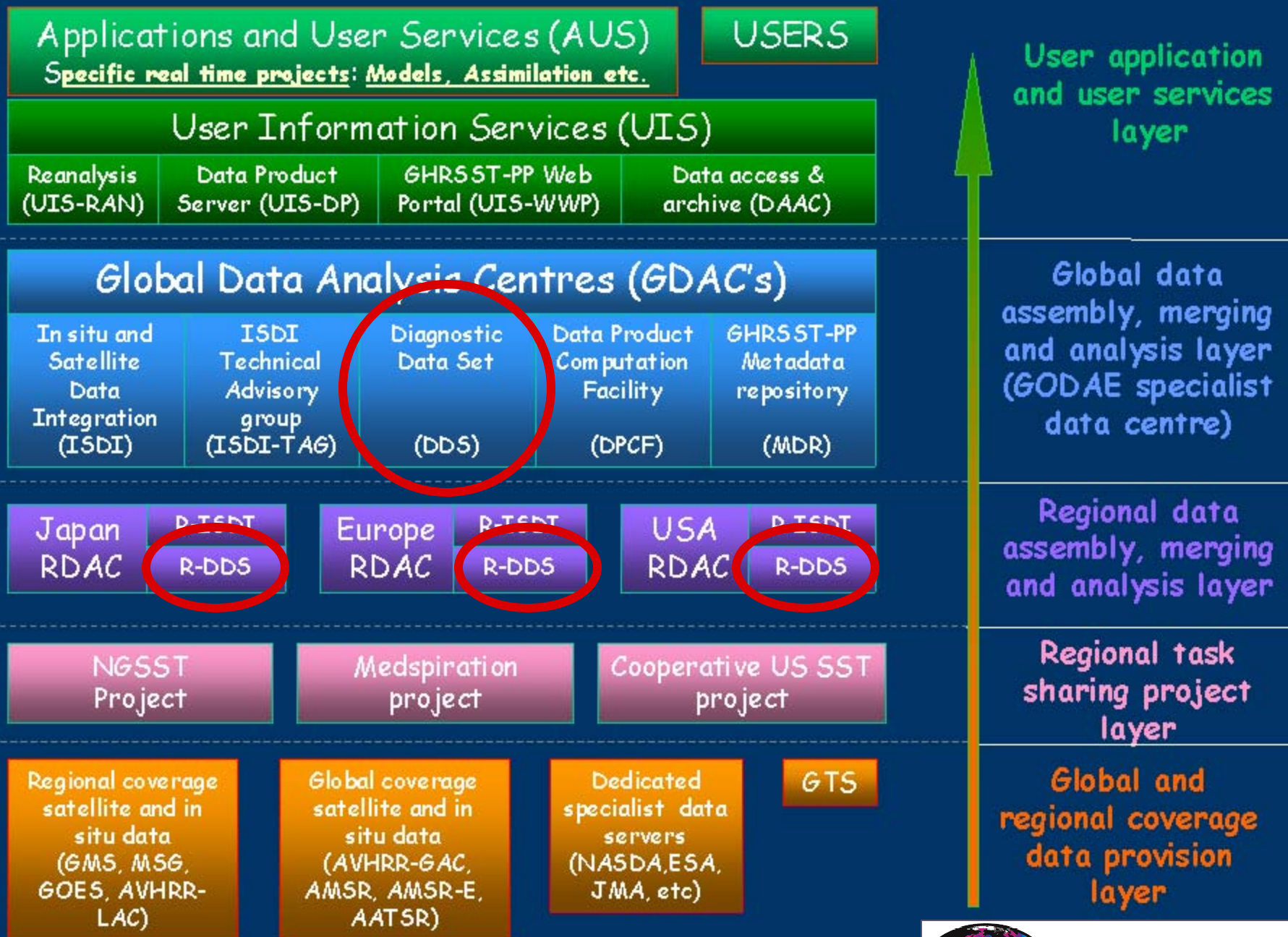
# NGSST v1.0 SST<sub>1m</sub> in the Kuroshio region

Analysis of NOAA AVHRR, GMS VISSR, TMI



Movie April 24 to 30, 2000. (Hiroshi Kawamura)





**GHR SST-PP**

GODAE High Resolution Sea Surface Temperature Pilot Project

\*RDAC: Regional Data Assembly Centre

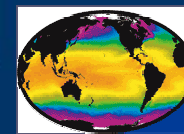
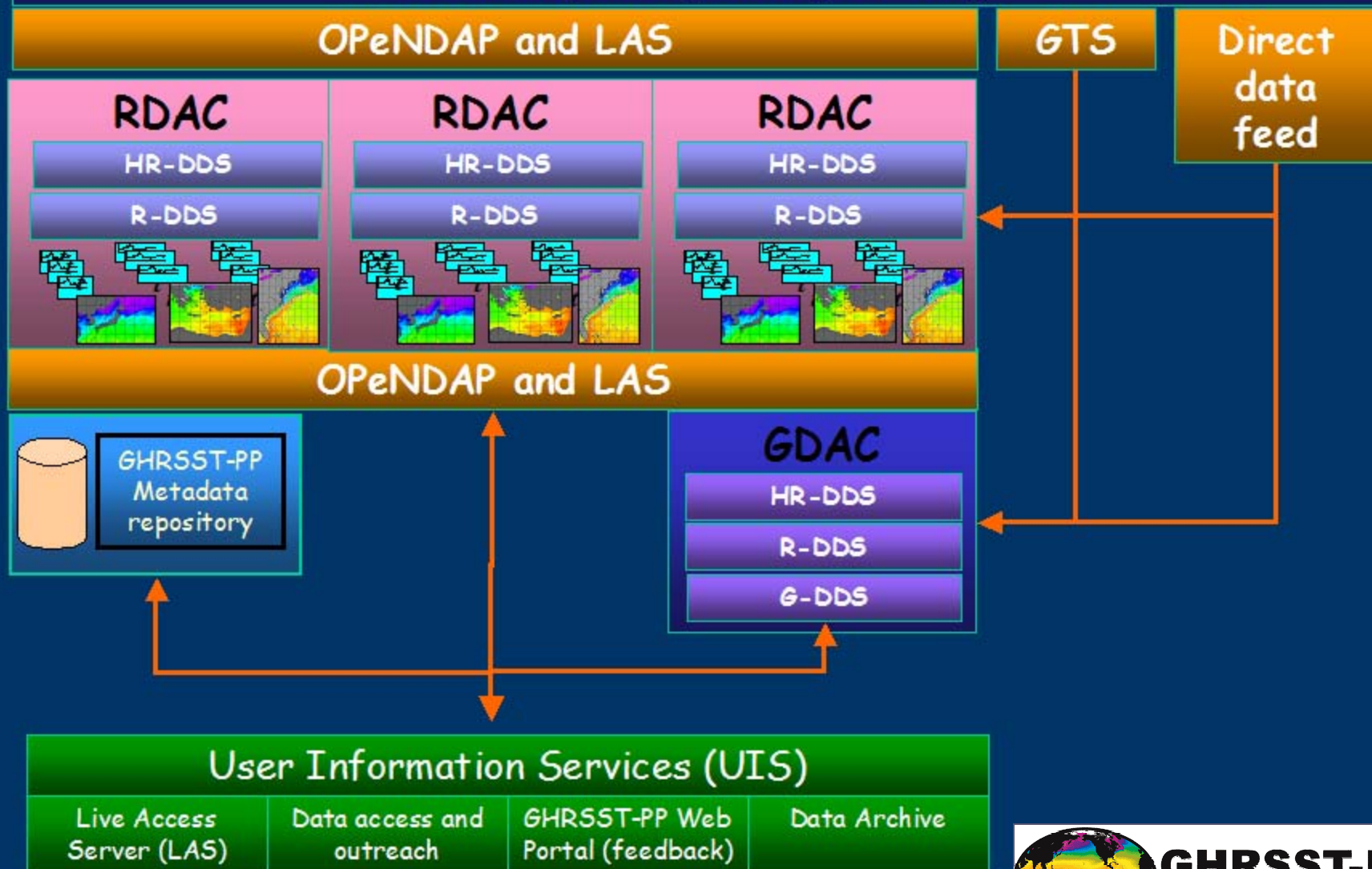
# The Diagnostic Data Set (DDS)

- ② The GHR SST-PP DDS is the GHR SST-PP **quality control tool**
  - Within the project
  - Within the AUS
- ② The **DDS is a resource for:**
  - **Monitoring** of input satellite data streams
  - Developing **new data merging strategies**, tools and methods
  - For **understanding differences** between complementary data
  - **Validating** and **monitoring** GHR SST-PP data products
- ② The DDS **may be implemented as a distributed system** (e.g., using OPeNDAP and LAS) linked via the GHR SST-PP metadata repository



# GHR SST-PP Diagnostic Data Set (DDS)

Distributed In Situ, Satellite and model data sets (SST, wind, solar radiation, fluxes, SOOP, DBP etc)

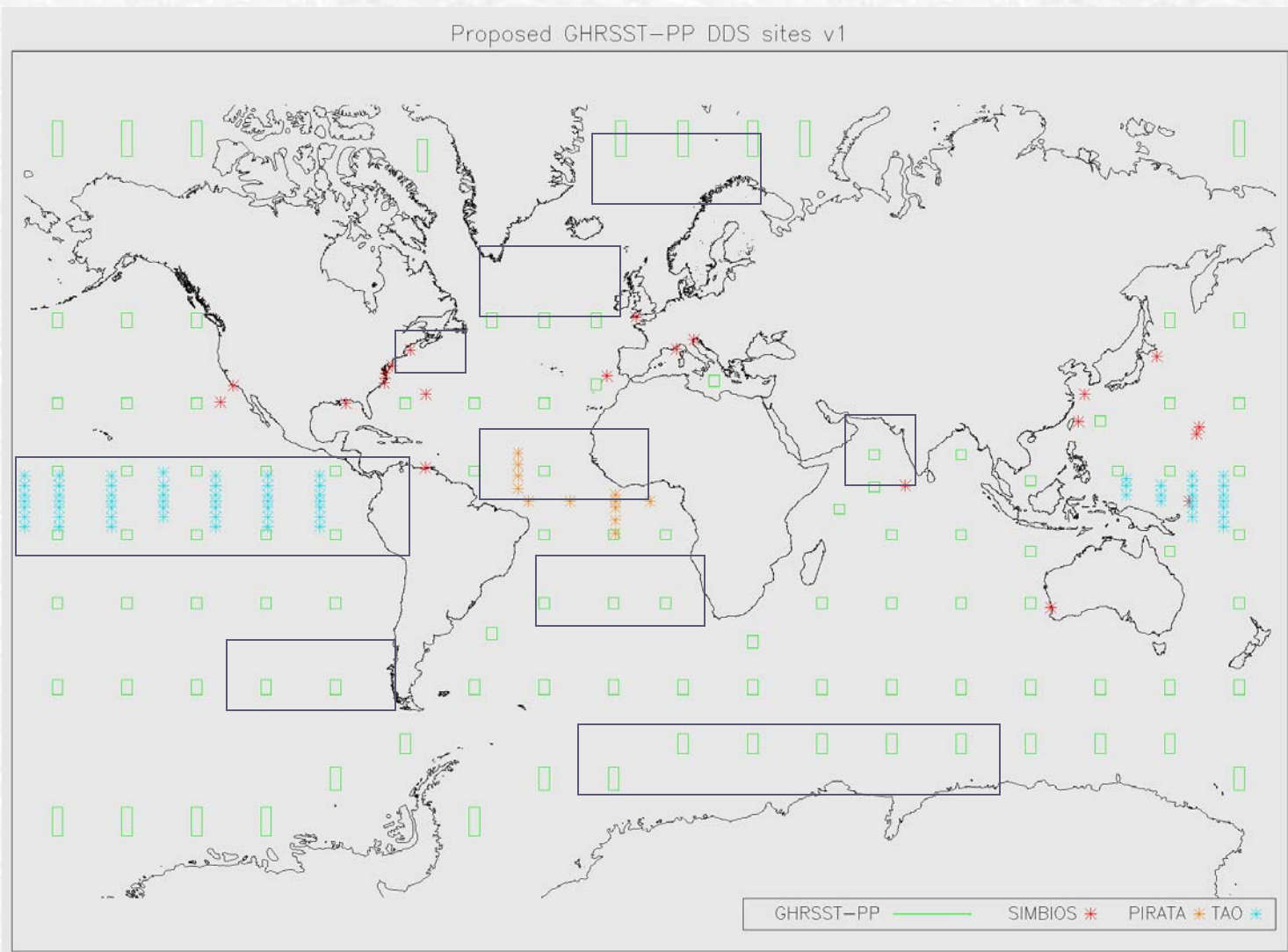


**GHR SST-PP**

GODAE High Resolution Sea Surface Temperature  
Pilot Project



# GHR SST-PP example DDS locations



# Expected GHRST-PP Outcomes

- ② Provide a **new generation of operational SST** products
  - Address the needs of national and international projects (GODAE, GOOS, WOCE, CLIVAR, MERCATOR etc.)
- ② Ensure that **duplication of SST activities are minimized**
  - Synchronization of data merging/processing procedures, techniques, algorithms and data formats,
- ② An **operationally efficient methodology** for real time fusion of SST data
  - Increased efficiency and cost-effectiveness of SST product generation and delivery
- ② Develop and foster **considerable scientific and operational knowledge** during the lifecycle of the GHRST-PP
  - Increase the network capacity within international and national projects of differing scope and budget

# Evaluation of the GHR SST-PP

④ The success of the GHR SST-PP will be evaluated primarily on:

- The **completeness** of a new generation merged high-resolution SST maps,
- Their **wide application** in operational and scientific fields,
- And in particular, their **operational use in oceanographic and meteorological** community data assimilation activities (GODAE).
- The **continuation of GHR SST-PP activities** by operational agencies tasked with providing SST products



# Implementation

- ④ The **GHR SST-PP Strategy** has now been reviewed and published. (in the coming months as a GODAE report)
- ④ A **2nd GHR SST-PP workshop** (*“Removing Barriers to the Implementation of the GHR SST-PP”*) dedicated to the detailed implementation of the GHR SST-PP project was held in Tokyo, May 2002. **Reports in preparation.**
- ④ **Implementation consolidation workshop** will be at ESA ESRI, Frascati, Italy in December 2002, **Demonstration phase workshop**, will be at JPL, USA, mid 2003
- ④ **Regional high profile projects** supporting GHR SST-PP are either **in place** (NASDA NGSST project and AMSR data server) or **in preparation** to start in 2003 (ESA Medspiration initiative, US Co-operative SST)
- ④ **GHR SST-PP is on target** to deliver a new generation of SST demonstration data products, in real time, during the 2003-2005 period